IS 1121 (Part 4) : 2013

(Reaffirmed 2017)

भारतीय मानक

प्राकृतिक निर्माण पत्थरों के सामर्थ्य गुणों को ज्ञात करना — परीक्षण पद्धतियाँ

भाग 4 कर्तन सामर्थ्य

(दूसरा पुनरीक्षण)

Indian Standard

DETERMINATION OF STRENGTH PROPERTIES OF NATURAL BUILDING STONES — METHODS OF TEST

PART 4 SHEAR STRENGTH

(Second Revision)

ICS 91.100.15

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

January 2013 **Price Group 3**

Stones Sectional Committee, CED 6

FOREWORD

This Indian Standard (Part 4) (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Stones Sectional Committee had been approved by the Civil Engineering Division Council.

Building stones are available in large quantity in various parts of the country and to choose and utilize them for their satisfactory performance, it is necessary to know the various strength properties determined according to standard procedure. This standard has, therefore, been formulated to cover the standard method for determining the strength properties of various stones. This standard covering compressive, transverse and shear strength properties was published in 1957 and was subsequently revised in 1974 where property of tensile strength was also added as the same was also important for assessing the suitability of stone; the revision was issued in four parts. Other parts are:

Part 1 Compressive strength
Part 2 Transverse strength
Part 3 Tensile strength

This standard is brought out to incorporate the experience gained based on the use of the standard since its last revision. The major modifications incorporated in this revision are as follows:

a) SI units have been used,
b) Size of the samples has been specified as ‘stones of adequate size’ in place of the requirement of at least 25 kg specified earlier,
c) Surface finishing requirement of specimen has been modified by making reference to IS 9179 : 1979 ‘Method for preparation of rock specimen for laboratory testing’,
d) Vacuum saturation in water has been specified for conditioning of the test specimens in place of normal immersion,
e) The word ‘rift’ has been replaced with ‘plane of anisotropy’, and
f) The minimum number of test specimen has been revised from three to five for test for each of the set of conditions.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’.

Indian Standard

DETERMINATION OF STRENGTH PROPERTIES OF NATURAL BUILDING STONES — METHODS OF TEST

PART 4 SHEAR STRENGTH

(Second Revision)

1 SCOPE

This standard (Part 4) lays down the procedure for determination of shear strength of natural building stones used for constructional purposes.

2 REFERENCE

The following Indian Standard contains provision which through reference in this text, constitutes provision of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision and parties to agreements based on this standard is encouraged to investigate the possibility of applying the most recent edition of the standards indicated below:

IS No.	*Title*
9179 : 1979	Method for preparation of rock specimen for laboratory testing

3 SELECTION OF SAMPLES

3.1 The sample shall be selected to represent a true average of the type or grade of stone under consideration.

3.2 The sample shall be selected from the quarried stone or taken from the natural rock, as described in **3.2.1** and **3.2.2** and shall be of adequate size to permit the preparation of the requisite number of test specimens.

3.2.1 *Stones from Ledges or Quarries*

The ledge or quarry face of the stone shall be inspected to determine any variation in different strata. Differences in colour, texture and structure shall be observed. Separate samples of stone of adequate size of the unweathered specimens shall be obtained from all strata that appear to vary in colour, texture and structure. Specimens that have been damaged by blasting, driving wedges, heating, etc, shall not be included in the sample.

3.2.2 *Field Stone and Boulders*

A detailed inspection of the stone and boulders over the area shall be made where the supply is to be obtained. The different kinds of stones and their conditions at various quarry sites shall be recorded. Separate samples for each class of stone that would be considered for use in construction as indicated by visual inspection shall be selected.

3.2.3 When perceptible variations occur in the quality of rock, as many samples as are necessary for determining the range in properties shall be selected.

4 TEST SPECIMENS AND CONDITIONING

4.1 Saws shall be used for making test pieces from samples selected in accordance with **3**. Use of hand tools, such as chisel for cutting shall not be permitted.

4.2 The load-bearing surfaces shall be finished to as nearly true, parallel and perpendicular planes as possible by using rock cuttings saws, grinding, polishing wheels or abrasive powder. The dimensions of the faces under loading shall be measured to the nearest 0.2 mm at the centre section.

4.3 The load-bearing surfaces shall be prepared in accordance with IS 9179.

4.4 The load-bearing surfaces and the direction of the plane of anisotropy shall be carefully marked on each test specimen after finishing.

4.5 Test piece for use in the Johnson shear tool shall be bars 50 mm × 50 mm in section and not less than 180 mm in length.

4.6 Test piece for use with the Dutton punching shear device shall be slabs 30 mm in thickness, 100 mm in width and not less than 100 mm in length.

4.7 Five test specimens shall be used for conducting the test in each of the conditions mentioned in **4.7.1** and **4.7.2** separately. In each of these conditions, separate tests shall be made for the specimen when the load is parallel to the plane of anisotropy and perpendicular to the plane of anisotropy. In all, twenty test specimens shall be used.

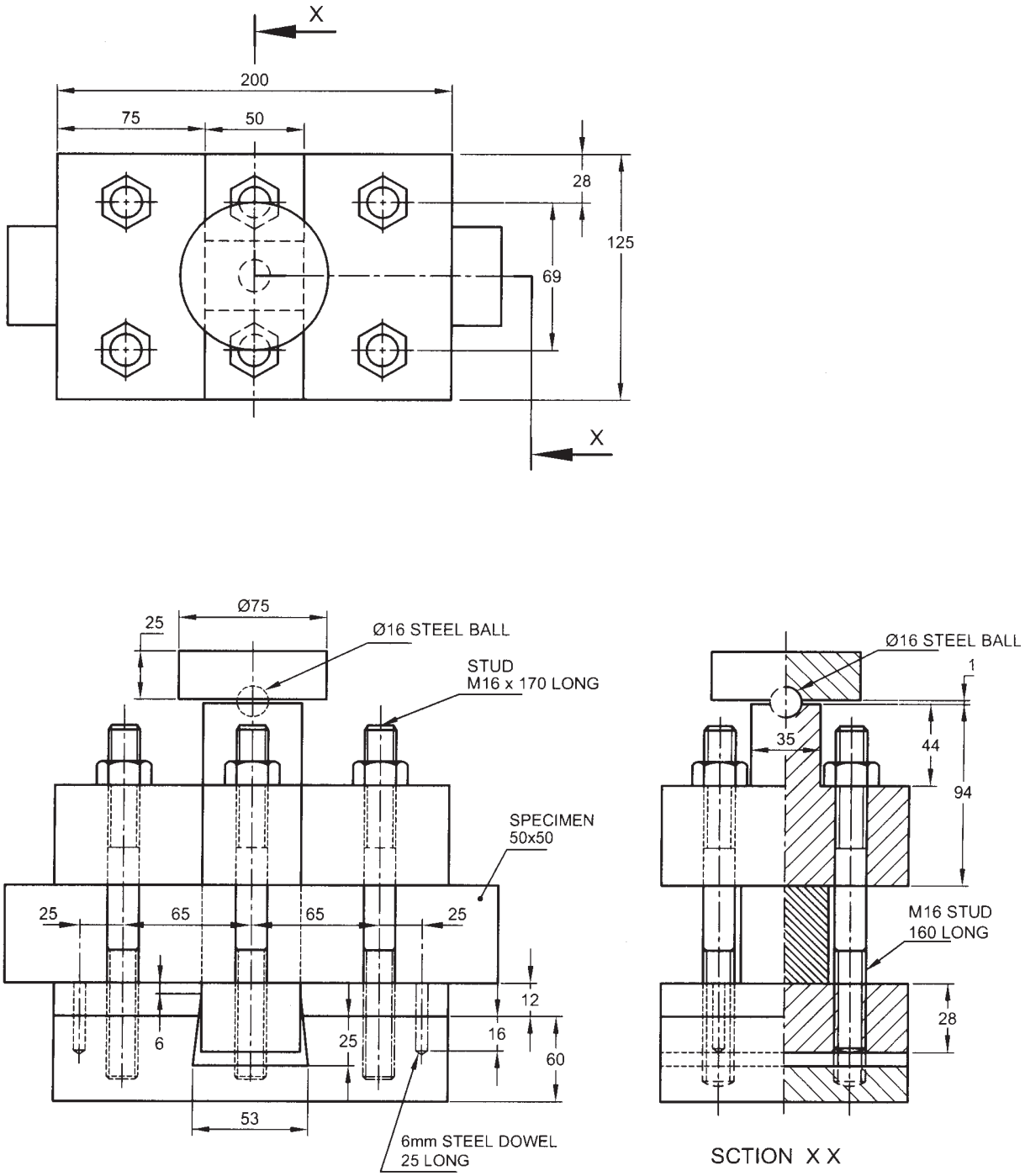
4.7.1 The test specimens shall be saturated by vacuum saturation by immersing in water maintained at 20 °C to 30 °C in an evacuation vessel under a vacuum of about 50 mm of Hg to 100 mm of Hg. Specimens shall be initially immersed continuously

for about 4 to 5 h in vacuum and then its mass is measured at an interval of 1 h (sample being replaced back in evacuation vessel after weighing) till constant mass. Constant mass is considered to have been achieved when two consecutive hourly measurement of mass do not vary by more than 0.1 percent of the saturated mass. Vacuum may be created by a suitable air suction pump.

4.7.2 The test specimens shall also be tested in a dry condition and shall be dried in an oven at 70 ± 5 °C for 48 h and cooled in a desiccator to room temperature (20 °C to 30 °C). Constant mass is considered to have been achieved when two consecutive hourly measurements of mass do not vary by more than 0.1 percent.

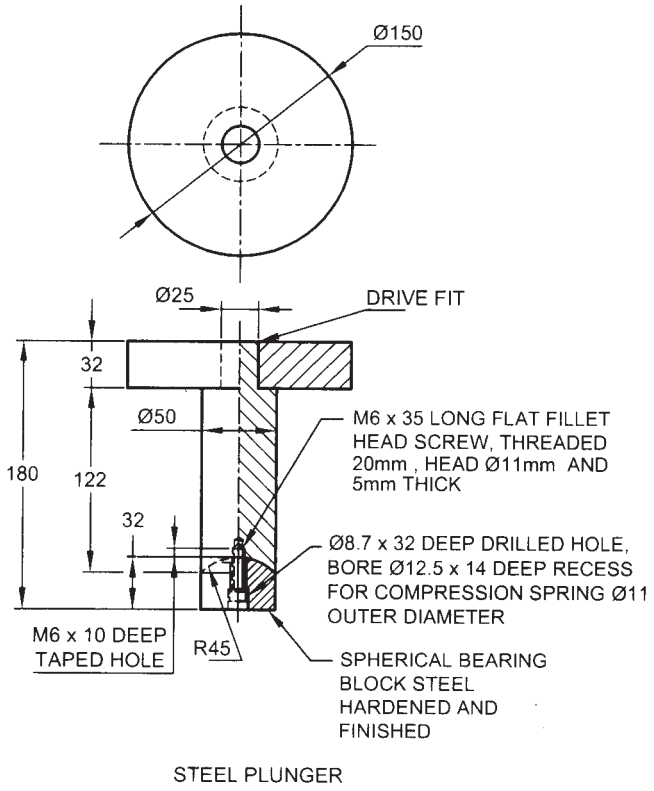
5 APPARATUS

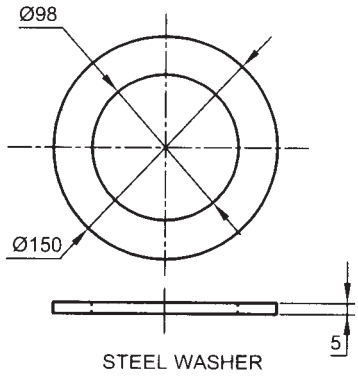
5.1 The apparatus shall be either the modified Johnson shear tool (*see* Fig. 1) or the Dutton punching shear device (*see* Fig. 2A and 2B) in conjunction with any standard testing machine of sufficient capacity.

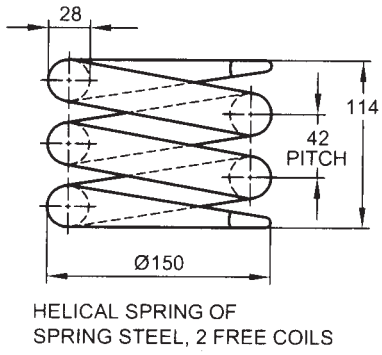


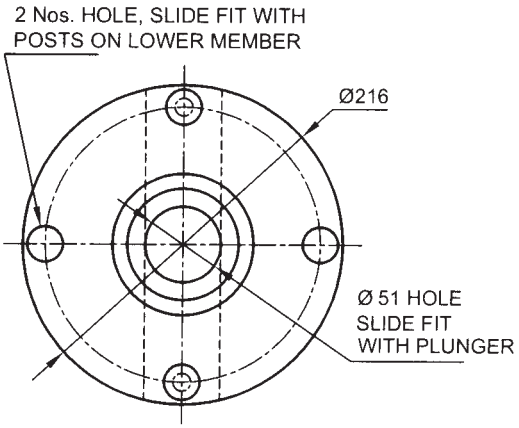
All dimensions in millimetres.

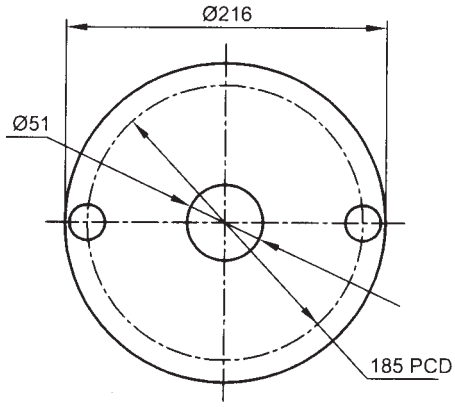
FIG. 1 DETAILS OF MODIFIED JOHNSON SHEAR TOOL

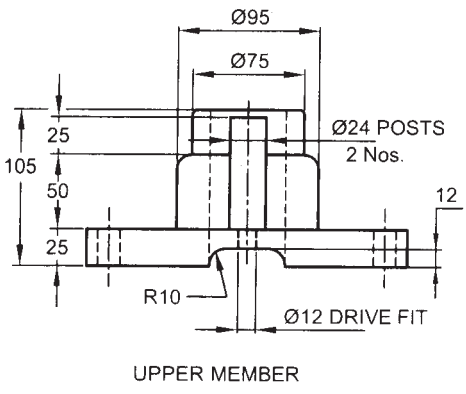


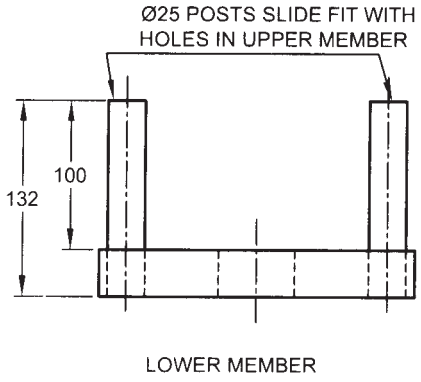












2A DETAILS OF PARTS

All dimensions in millimetres.

FIG. 2 DETAILS OF DUTTON PUNCHING SHEAR DEVICE (*Continued*)

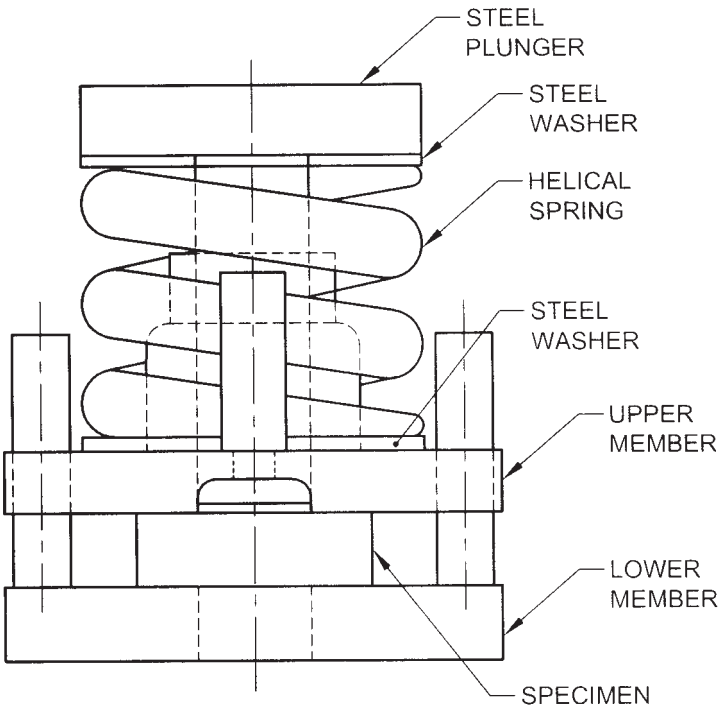


FIG. 2 DETAILS OF DUTTON PUNCHING SHEAR DEVICE

5.2 When the Dutton punching shear device is used, a spherical bearing block of sufficient size to cover the upper end of the plunger of the punching shear device shall be used.

6 PROCEDURE

6.1 Using Johnson Shear Tool

The test piece shall be carefully centred in the shear tool as shown in Fig. 1 and the bolts drawn up tightly. The tool shall then be centred in the testing machine with the centre of the spherical block in contact with the centre of the top portion of the plunger of the shear tool. Accurate adjustments shall be made by hand under a small initial load. The speed of the moving head of the testing machine during the application of the load shall be not more than 1 ml/min. During the test, the beam of the testing machine shall be kept constantly in a floating position.

6.2 Using Dutton Punching Shear Device

Centre lines shall be laid off on one surface of the slab and the thickness of the slab shall be measured to the nearest 0.2 mm at not Iess than three points approximately equidistant around the circumference of a 50 mm circle centred on the inter-section of the two centre lines. The test piece shall be carefully centred between the upper and lower plates of the punching device so that the measured section of the test piece is under the plunger. The upper plate shall be carefully lowered to contact the test piece. The punching device shall then be centred in the testing machine with the centre of the spherical bearing block in contact with the centre of the top portion of the plunger of the shear device. Accurate adjustment shall be made by hand under a small initial load. The speed of the moving head of the testing machine during the application of the load shall be not more than 1 ml/min. During the test, the beam of the testing machine shall be kept constantly in a floating position.

7 EVALUATION AND REPORT OF TEST RESULTS

7.1 Using Johnson Shear Tool

The shear strength of the test piece shall be calculated as follows:

$$S = \frac{W}{2A}$$

where

S = shear strength of standard test specimen in N/mm^2,

W = total maximum load in N indicated by the testing machine, and

A = area in mm^2 of the centre cross-section of the test piece.

7.2 Using Dutton Punching Shear Device

The shear strength of the test piece tested shall be

calculated as follows:

$$S = \frac{W_t - W_i}{\pi DT}$$

where

S = shear strength of standard test specimen in N/mm^2,
W_t = total maximum load in N indicated by the testing machine,
W_i = initial load in N,
D = diameter in mm of the plunger, and
T = thickness in mm of the specimen.

7.3 The average of the five results in each condition separately (*see* **4.4)** shall be taken for purposes of reporting the shear strength of the sample provided the individual variation is not more than ±15 percent of the average. Otherwise repeat tests shall be made.

7.4 Identification of the sample, date when sample was taken and type of stone shall be reported.

7.5 The size and shape of test piece used in the tests shall be indicated.

7.6 The type of shear appliance used shall also be indicated.

ANNEX A
(*Foreword*)

COMMITTEE COMPOSITION

Stones Sectional Committee, CED 6

Organization	*Representative(s)*
In personal capacity (*C-3/3188, Vasant Kunj, New Delhi*)	Dr A. K. Dhawan **(*Chairman*)**
A.P. Engineering Research Laboratories, Hyderabad	Director Joint Director (*Alternate*)
Associated Stones Industries (Kotah) Limited, Mumbai	Shri S. C. Agarwal
Builders Association of India, Mumbai	Shri Lal Chand Ralhan Shri Ram Avtar (*Alternate*)
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Central Public Works Department, New Delhi	Chief Architect (NDR) Senior Architect-IV (*Alternate*)
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Central Soil and Materials Research Station, New Delhi	Shri Murari Ratnam Shri Hasan Abdullah (*Alternate*)
Centre for Development of Stones, Jaipur	Shri Kulveer Singh
Directorate General Border Roads, New Delhi	Shri B. S. Pandey
Directorate of Geology & Mining, Lucknow	Representative
Directorate of Mines and Geology, Udaipur	Shri O. P. Jain Shri N. S. Bohra (*Alternate*)
Gem Granites, Chennai	Shri Shiv Shankar Shri Rajiv Bahadur (*Alternate*)
Geological Survey of India, Kolkata	Shri G. S. Murthy Dr G. M. Rao (*Alternate*)
Gujarat Engineering Research Institute, Vadodara	Shri L. V. Ashara Shri S. H. Makwana (*Alternate*)
Indian Bureau of Mines, Nagpur	Representative

Organization	*Representative(s)*
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Public Works Department, Government of Rajasthan, Jaipur	Shri Chiranji Lal Shri G. C. Panwr (*Alternate*)
Public Works Department, Government of Tamil Nadu, Chennai	Superintending Engineer Executive Engineer (General) (*Alternate*)
School of Planning and Architecture, New Delhi	Prof S. K. Khanna Shri Shuvojit Sarkar (*Alternate*)
Shriram Institute of Industrial Research, Delhi	Dr Laxmi Rawat Shri R. K. Singh (*Alternate*)
Stone Technology Centre, Jaipur	Shri K. Vikram Shri Vikrant V. Rastogi (*Alternate*)
Stone Technology Foundation, Jaipur	Shri Jayesh V. Rastogi
Svil Mines Ltd, Floriana Group, New Delhi	Shri Sanjay Jain Shri Manmohan Garg (*Alternate*)
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Amendments Issued Since Publication

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